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# The Republic of Korea's Economic Growth and Catch-Up: Implications for the People's Republic of China

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**Abstract**

This study investigates the economic growth and catch-up of the Republic of Korea over the past half-century. The gap of output per worker between the Republic of Korea and United States has decreased rapidly, as the Republic of Korea's lower per capita income, relative to its potential level, has led to higher growth, confirming the prediction of a conditional convergence theory. Cross-country regression further suggests that the Republic of Korea's catch-up to the United States is also attributable to strong investment, lower fertility, greater trade openness, and improvements in human resources and rule of law, while improvement in democracy tends to slow the pace of the catch-up. Yet as the Republic of Korea catches up to the United States and its steady-state level in per worker output, it is subject to growth slowdown unless it improves institutions and policy factors. While manufacturing- and export-oriented development served the Republic of Korea's success well, poor productivity performance in the services sector has hampered overall productivity growth. The Republic of Korea's experience implies that the People's Republic of China's potential growth rates are likely to slow in the coming decades due to the convergence effect and with the rebalancing toward a domestic consumption and services-based economy. The People's Republic of China needs to upgrade its institutional quality and improve productivity, particularly in its services sector, to sustain strong growth.

**JEL Classification:** O11, O14, O19, O47, O53, O57

# Contents

# 1. INTRODUCTION

The Republic of Korea has had a remarkable economic performance since the early 1960s, achieving per capita income of $27,000 to become the world's eighth-largest trading nation.[1] However, the economy's recent growth performance has been rather disappointing. Gross domestic product (GDP) growth averaged only 4.1% during 2000–2010, marking a significant drop from the average of 7.9% achieved during 1960–2000. Moreover, from 2011 to 2015, the Republic of Korea's GDP growth averaged only 3.0%. The Organisation for Economic Co-operation and Development (OECD) (2014a) has projected a further decline in the country's growth rate to around 2.0% in the coming decade.

Some researchers argue that the Republic of Korea's strong economic performance is an outcome of factor accumulation rather than efficiency improvement (e.g., Krugman 1994), while others attribute the growth largely to "good fundamentals," including a high savings rate, strong human capital, maintenance of good institutions, high trade openness, and prudent fiscal and monetary management (e.g., Radelet, Sachs, Lee 2001; De Gregorio and Lee 2004). In particular, trade openness, driven by outward-looking development strategy, has often been emphasized as a key growth factor, as it has provided access to inexpensive imported intermediate goods, larger markets, and advanced technologies, thereby contributing to rapid productivity growth of the Republic of Korea's manufacturing industries. The government has also played an important role in promoting export-oriented industrialization, as export-oriented policies designed to offer performance-based incentives for exporters have facilitated continuous upgrading of Republic of Korea firms' comparative advantage in global markets.[2]

It is debated whether the Republic of Korea's current slowdown is an indication of a permanent drop in its growth potential. Some scholars believe that the Republic of Korea's economic downturn will be exacerbated, eventually leading to a situation comparable to Japan's "lost decades" (Cho 2014). Others, however, consider that the dynamic forces that have enabled the Republic of Korea's fast growth—in particular manufacturing exports—remain vibrant; thus, the Republic of Korea can continue its strong growth trajectory aided by appropriate policies (Sharma 2012).

This study investigates the Republic of Korea's growth performance and assesses the country's future growth prospects. The changes in the country's per capita income and growth rates over the past 5 decades are discussed and compared with Japan. This study also assesses changes in the gap of per worker output between the Republic of Korea and United States (US) over time, and analyzes the extent to which the gap is explained by differences in factor inputs and total factor productivity (TFP). In addition, the study adopts a general framework of cross-country analysis, putting the Republic of Korea's experience in a global context, discussing the major factors that enabled the Republic of Korea to achieve strong growth over a half-century yet caused the recent growth slowdown. Further, the study adopts more detailed industry-level data of the Republic of Korea's economy to assess the imbalance between the manufacturing and

[1] Gross national income per capita in 2014 is from World Bank (2015).

[2] It remains controversial to what extent industrial policy that targets specific industries has contributed to overall economic growth. The developmental state view, such as that of Amsden (1992), argued that selective government policies attempted to "pick winners." In contrast, the World Bank (1993) asserted that government intervention conformed to the market, rather than replaced the market, using a pragmatic and flexible approach. Lee (1996) showed that targeting specific industries was often harmful to productivity growth of the overall economy.

services sectors, and compares the Republic of Korea's sector performance with those of the US and Japan.

Thereafter, the study assesses the implications of the empirical findings from the Republic of Korea's experience for the growth performance and prospects of the People's Republic of China (PRC).

The PRC's economic performance since the 1980s has been astonishing—its economy has grown more than 9.5% annually. However, its economy, too, is now slowing; it grew only 6.9% in 2015, the lowest since 1990, and is predicted to grow more slowly in the coming years. Considering the PRC's influence on the world economy, the future of its growth is of concern to many. This study analyzes PRC economic growth in the context of global standards as well as the Republic of Korea's experience. It discusses the changes in the gap of per worker output between the PRC and US over time and compares the performance of the PRC with that of the Republic of Korea for an equivalent period. It also suggests policy measures that the PRC could adopt to sustain strong growth.[3]

# 2. THE REPUBLIC OF KOREA'S ECONOMIC GROWTH AND CATCH-UP

## 2.1 The Experience of the Republic of Korea

During the past half-century, the Republic of Korea's economy has shown impressive growth, with average annual GDP growth rate surpassing 7.1%, raising the level of real per capita GDP in international prices almost 26 times (Table 1). Average GDP growth rates accelerated to 7.5% in the 1960s, 8.6% in the 1970s, and 9.3% in the 1980s, but the impressive performance was interrupted by the 1997/98 Asian financial crisis. This sudden crisis had a devastating effect on the Republic of Korea's economy, with real GDP falling by almost 7.0% in 1998, due to the huge, sudden reversal of short-term capital flows triggered by international investor panic (Radelet, Sachs, Lee 2001). Structural problems underlying the economy, including undersupervised financial systems and an overleveraged corporate sector, also led to the accumulation of vulnerabilities that set the stage for the crisis and amplified its shock to the economy.

The Republic of Korea managed to recover rapidly from 1999—faster than anyone had expected. However, there seems to have been a permanent decline in growth potential, as the average GDP growth rate remained at 4.1% over 2000–2010.

The global financial crisis in 2008–2009, which evolved from the US subprime mortgage crisis, also seriously affected the Republic of Korea's economy through spillovers from global trade and financial markets. The country's GDP growth rate dropped to 0.3% in 2009. Although the Republic of Korea managed the global financial crisis relatively well, showing the fastest recovery among OECD members, its economy still has not yet resumed its pre-crisis growth rates.

[3] Japan's experiences, in particular asset bubble burst and long-term stagnation since the early 1990s, can be also useful for PRC policy making. However, the PRC's per capita output, as well as economic structure, lags over 40 years behind those of Japan, which makes difficult to compare two economies and draw useful policy implications for the PRC.

**Table 1: Economic Growth in Selected Countries, 1960–2010**

| | GDP per Capita | | | Average Annual GDP Growth | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Country | 1960 | 2010 | 2010/ 1960 | 1960–1970 | 1970–1980 | 1980–1990 | 1990–2000 | 2000–2010 | 1960–2010 |
| Republic of Korea | 1,078 | 27,578 | 25.59 | 7.45 [4.82] | 8.58 [6.83] | 9.28 [7.90] | 6.33 [5.65] | 4.07 [3.60] | 7.14 [5.76] |
| Japan | 4,795 | 30,916 | 6.45 | 9.66 [8.62] | 4.37 [3.25] | 4.53 [4.00] | 1.12 [0.84] | 0.74 [0.68] | 4.08 [3.48] |
| United States | 15,254 | 42,371 | 2.78 | 4.11 [2.84] | 3.19 [2.26] | 3.18 [2.20] | 3.37 [2.28] | 1.52 [0.58] | 3.07 [2.03] |
| People's Republic of China | 1,057 | 8,426 | 7.97 | 3.24 [0.92] | 6.03 [4.15] | 8.87 [7.34] | 9.92 [8.89] | 9.95 [9.40] | 7.61 [6.14] |

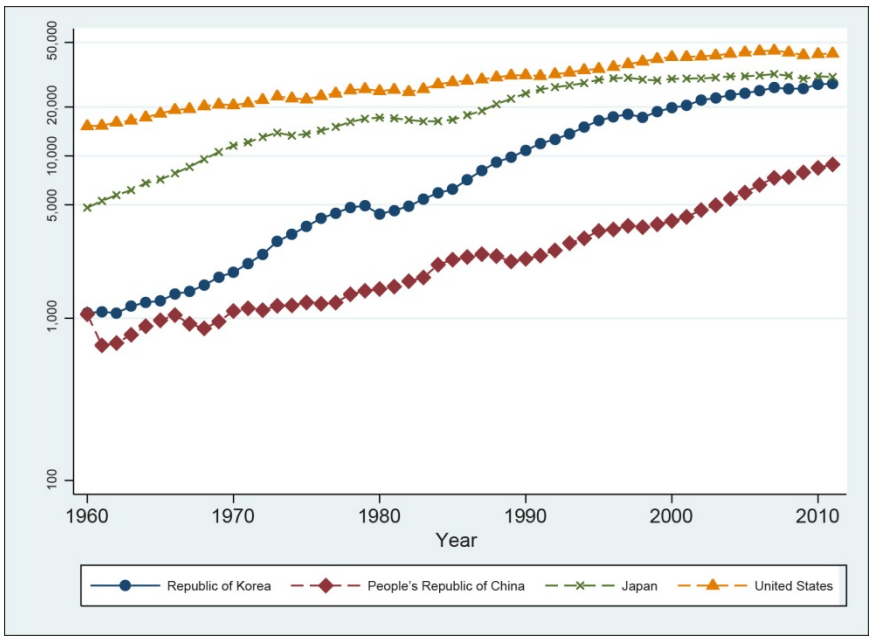
GDP = gross domestic product.

Note: Per capita GDP levels and growth rates are based on the international prices of 2005 (adjusted for purchasing power parity), which are based on the Penn World Table 8.1 in Feenstra, Inklaar, Timmer (2015).

Source: Feenstra, Inklaar, Timmer (2015).

Over the past half-century, due to the Republic of Korea's strong growth performance, its economy has experienced a fast catch-up to advanced economies in per capita output and income (Figure 1).[4] The Republic of Korea has achieved the high-income level in a half-century, with per capita income of $27,578 purchasing power parity (PPP) in 2010. In 1960, it was still a lower-middle income country, with a per capita GDP of only $1,078 PPP.

**Figure 1: Trends in per Capita Gross Domestic Product in Selected Economies**
(purchasing power parity international dollar, 2005 constant prices)




Source: Feenstra, Inklaar, Timmer (2015).

[4] For an international and intertemporal comparison, this study uses data on per capita GDP at PPP international dollars from the Penn-World Table 8.1 in Feenstra, Inklaar, and Timmer (2015).

Japan has also experienced a significant growth slowdown since early 1990s. The burst of asset bubbles in the 1990s left Japan's financial system and private sector saddled with a huge debt overhang. During its "lost decades," Japan suffered from deflation and economic stagnation due to its dysfunctional financial system and lack of private demand. Consequently, the gap in per capita GDP between Japan and the Republic of Korea has narrowed rapidly, and has been close to zero in recent years.

In the last 35 years, since Deng Xiaoping embarked on economic opening and reforms, the PRC has shown astounding output growth of more than 9.5% annually. It has rapidly narrowed its per capita output gap with advanced economies. Yet despite this stellar performance, the country's per capita output continues to lag behind those of advanced economies. The GDP per capita in 2011 was $8,850 PPP, which is comparable to the Republic of Korea's 1988 level (i.e., $9,137 PPP) and Japan's 1968 level (i.e., $9,527 PPP). The PRC is thus more than 20 years behind the Republic of Korea and more than 40 years behind Japan.

Figure 2 shows the evolution of per capita GDP levels of the three Asian economies relative to the US over time. The values are 5-year averages, matched with average GDP growth rates in the corresponding period.[5] The Republic of Korea's sustained growth contributed to narrowing the gap in its per capita GDP with the US, as it experienced a very rapid catch-up to the US in per capita output. The value of per capita output increased from approximately 10% of the US value in 1960 to more than 60% in the late 2000s.

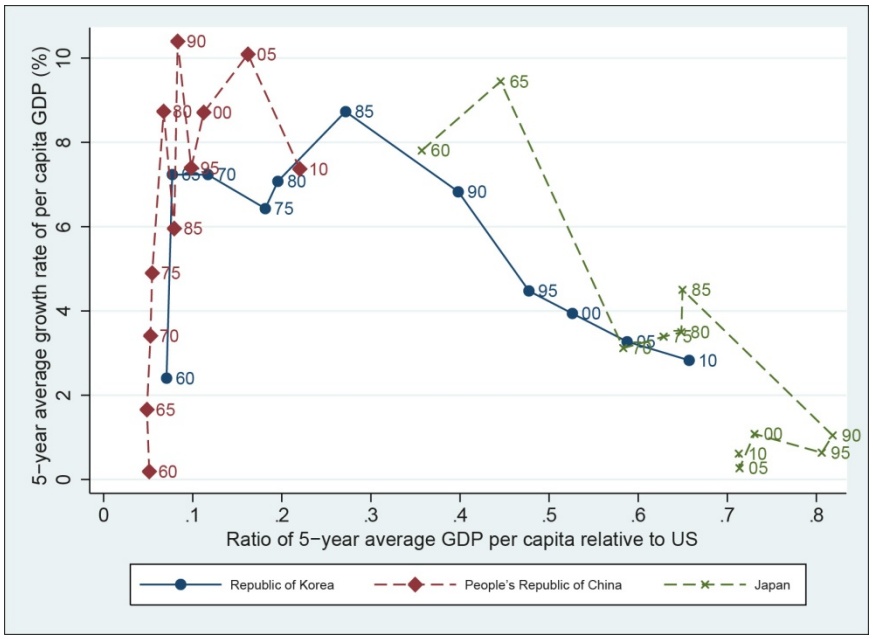
Figure 2 shows that the pace of the catch-up slowed as the Republic of Korea economy narrowed its per capita income gap compared to that of the US. While income per capita in the Republic of Korea was less than 20% of the US average in the 1970s and 1980s, annual per capita GDP growth reached only 7%–8%. By the time the Republic of Korea reached 50% of US per capita income in 2000, its annual growth rate had slowed to 3%–4%.

The Republic of Korea experience resembles that of Japan. Japan's annual per capita GDP growth dropped from 8.6% in the 1960s to 3%–4% in the 1970s and 1980s as its per capita income jumped from about 40% to over 60% of the US level over the period (Figure 2).

The evolution of per capita income and growth rates over time can be explained by the conditional convergence theory. Conditional convergence of per capita (or per worker) output is predicted by an extended version of the neoclassical growth model, as described by Barro and Sala-i-Martin (2004). A country with a low initial per capita output relative to its own long-run (or steady-state) potential level of per capita output grows faster than a country with a higher level of per capita output. The basic concept is that the farther a country is located from its steady-state output or income level, the greater the gap of reproducible physical and human capital stock and productivity (i.e., technology) from its long-run levels. The gap of existing physical and human capital from steady-state levels offers the chance for a rapid catch-up via high rates of physical and human capital accumulation, which are encouraged by higher rates of return on investment. In addition, the greater technology gap stimulates faster productivity improvement via the diffusion or imitation of technology from more technologically advanced economies. Therefore, the lower the initial level of per capita output relative to the steady state, the higher the subsequent growth.

[5] The underlying data are the adjusted PPP values from the Penn-World Table 8.1 in Feenstra, Inklaar, and Timmer (2015). For 2012, 2013, and 2014, the values are estimated from information on real GDP growth rates from IMF (2015).

**Figure 2: Per Capita Income Level and Growth Rates of the People's Republic of China, Republic of Korea, and Japan Relative to the United States**




GDP = gross domestic product, US = United States.

Note: The figure shows the period average of relative per capita income and its growth rates over the corresponding 5 years. For 5-year periods, 60 indicates 1960–1964, …, and 10 indicates 2010–2014. The data from 2012 to 2015 are from IMF (2015).

Source: Author's calculations based on data from Feenstra, Inklaar, Timmer (2015) and IMF (2015).

## 2.2 Catch-Up and Convergence in Output and Productivity

This subsection assesses the role of factor accumulation and productivity increase in the evolutionary process of the gap in income between two countries. The aggregate production function is used, and the level of per worker output is decomposed into productive inputs, including physical and human capital, and TFP based on the development accounting approach (Hall and Jones 1999).[6]

A simple Cobb–Douglas production function is assumed:

$$Y = AK^{(1-\alpha)}(hL)^{\alpha}, \quad (1)$$

where $Y$ is value-added output (GDP), $K$ is physical capital, $L$ is the number of workers, $h$ is human capital per worker, and $A$ is TFP. The labor share of output is given by $\alpha$, which varies across countries and over time.

At the per worker level, the production function can be written as

$$y = Ak^{(1-\alpha)}h^{\alpha}, \quad (2)$$

To assess how much of the gap in $y$ is explained by differences in the two productive inputs, $k$ and $h$, and in the TFP, the ratio of per worker output between two countries, $i$ and $j$, is expressed as

[6] Lee (2005) adopted the same methodology to analyze the Republic of Korea's catch-up process over 1970–2000.

$$y_i/y_j = (\bar{k}_i/\bar{k}_j)(\bar{h}_i/\bar{h}_j)(A_i/A_j), \quad (3)$$

where $\bar{k} = k^{(1-\alpha)}$, $\bar{h} = h^{\alpha}$.

Equation (3) enables the decomposition of the differences in per worker GDP between two countries into the differences in the physical capital–labor ratio, human capital per unit of labor, and TFP. Note that this framework relies on several simplifying assumptions. The estimate of TFP, which is an unobservable "residual," may incorporate many elements other than productivity, such as natural resources and business cycle factors. The distinction between factor accumulation and technology (i.e., productivity) increase is often ambiguous, because *A*, *k*, and *h* are not independent of each other.

The US is considered a reference country (*j*) in equation (3). Thus, the value of each term in equation (3) indicates the level of per worker output, physical capital per worker, human capital per worker, and TFP of the Republic of Korea (*i*) relative to that of the US.

To conduct the decomposition of output, data on GDP and physical capital stock are collected from the Penn-World Table 8.1 (Feenstra, Inklaar, Timmer 2015). Labor shares are assumed to be 0.6 across countries and over time. The working-age population, sourced from the United Nations (2015), is used as a measure for the number of workers. The available cross-country sources of labor force or employees are less reliable than those of the working-age population.

Human capital per worker is measured by the sum of the shares of workers across all education categories weighted by their relevant productivity, measured by relative wage rates (Barro and Lee 2015). The relative wage rate of a worker with schooling is calculated by assuming a constant marginal return rate to an additional year of schooling of 10%, which is the world average (Psacharopoulos 1994).

Table 2 presents the evolution of the gap in per worker output between the Republic of Korea and US over time, while assessing the sources of the Republic of Korea's catch-up to the US. The Republic of Korea experienced a very rapid catch-up in per worker output over time. The value of per worker output increased from 8% of the US value in 1960 to 61% in 2010. The output catch-up process is associated with strong catch-up in physical and human capital accumulation and TFP. Physical capital shows the fastest expansion: the level of physical capital stock per worker in the Republic of Korea relative to that of the US increased tremendously from 7% in 1960 to 78% in 2010. This contrasts with the increase in the relative levels of human capital per worker from 60% to 97%, and TFP from 31% to 68% over the same period.

In addition, Table 2 shows that the pace of productivity catch-up slowed during 2000–2010. Indeed, the relative level of productivity decreased, although only marginally from 70% to 68% during this period. Note that this could have been caused by not only the slowdown of the Republic of Korea's productivity growth, but also the relatively high growth rates of productivity of the US economy in the early 2000s.

Table 2 also details the sources of Japan's catch-up in per worker output over time. For example, in 1960, the value of per worker output in Japan was only 29% of the value in the US, but rose to 78% in 2010. As in the Republic of Korea, in Japan, physical capital accumulation showed the fastest growth in this catch-up process. The level of physical capital stock per worker in Japan relative to that of the US increased from 17% in 1970 to 115% in 2010, contrasting with a moderate increase in the level of productivity from 66% to 78% of the US over the same period. Yet the pace of Japan's catch-up in per worker output has slowed since 1990. The level of per worker output in Japan relative

to the US increased only marginally from 73% in 1990 to 78% in 2010, probably due to the decline in productivity. The relative level of productivity in Japan deteriorated from 90% in 1990 to 80% in 2000 and further to 78% in 2010. By contrast, the relative levels of physical capital stock and human capital stock per worker continued to increase over the same period.

**Table 2: Output per Worker and Its Components: Ratio to United States Values, 1960–2010**

| Country | Year | Per Worker Output | Physical Capital per Worker | Human Capital per Worker | Total Factor Productivity |
|---|---|---|---|---|---|
| Republic of Korea | 1960 | 0.08 | 0.07 | 0.60 | 0.31 |
| | 1970 | 0.11 | 0.10 | 0.64 | 0.38 |
| | 1980 | 0.20 | 0.15 | 0.69 | 0.53 |
| | 1990 | 0.33 | 0.24 | 0.81 | 0.67 |
| | 2000 | 0.47 | 0.45 | 0.88 | 0.70 |
| | 2010 | 0.61 | 0.78 | 0.97 | 0.68 |
| Japan | 1960 | 0.29 | 0.17 | 0.83 | 0.66 |
| | 1970 | 0.50 | 0.37 | 0.75 | 0.88 |
| | 1980 | 0.69 | 0.69 | 0.76 | 0.93 |
| | 1990 | 0.73 | 0.78 | 0.83 | 0.90 |
| | 2000 | 0.74 | 1.03 | 0.87 | 0.80 |
| | 2010 | 0.78 | 1.15 | 0.92 | 0.78 |
| People's Republic of China | 1960 | 0.07 | 0.02 | 0.50 | 0.47 |
| | 1970 | 0.06 | 0.02 | 0.50 | 0.39 |
| | 1980 | 0.06 | 0.03 | 0.52 | 0.37 |
| | 1990 | 0.07 | 0.04 | 0.54 | 0.35 |
| | 2000 | 0.09 | 0.09 | 0.59 | 0.34 |
| | 2010 | 0.17 | 0.20 | 0.61 | 0.44 |

Notes: Data on output and physical capital stock are sourced from Feenstra, Inklaar, Timmer (2015), and data on the working-age population are sourced from the United Nations (2013). Human capital per worker is measured by the weighted sum of the shares of workers multiplied by the relative wage rates across all education categories. Relative wage rates are constructed assuming that the rates of return to an additional schooling year are constant at 10%.

Source: Author's calculations.

In addition, Table 2 shows that there is a significant difference in the levels of per worker output between the PRC and the three advanced economies in the study. In 2010, the value of per worker output in the PRC was only 17% of that value in the US, comparable to the Republic of Korea's 1980 level (i.e., 20%).[7] The PRC's physical capital stock per worker level (20%) in 2010 relative to the US level is comparable to the Republic of Korea's level in the 1980s. The PRC's relative productivity level (44%) in 2010 is lower than that of the Republic of Korea in 1980.

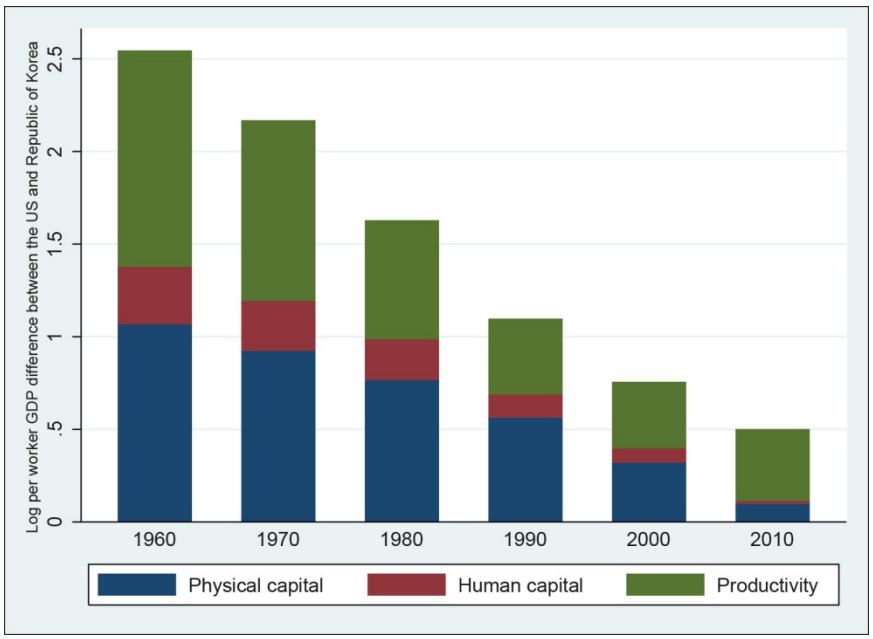
Equation (3) can be transformed by taking logs to express the log difference in per worker output of the Republic of Korea with the US as an additive sum of three components:

[7] Considering that the PRC has grown much faster that the US over the past 5 years, the value of per worker output in the PRC in 2015 is estimated to be approximately 23% of that value in the US. Note that the gap in per worker output of the PRC with US is much larger than that in per capita output, because the PRC has a larger share of workers in total population than the US.

$$\ln\left(\frac{y_{US}}{y_K}\right) = \ln\left(\frac{\overline{k_{US}}}{\overline{k_K}}\right) + \ln\left(\frac{\overline{h_{US}}}{\overline{h_K}}\right) + \ln\left(\frac{A_{US}}{A_K}\right) \quad (4)$$

Figure 3 shows the gap of per worker output and its sources at 10-year intervals from 1960 to 2010. In 1960, US per worker output was about 12.5 times the Republic of Korea's per worker output, which are decomposed into differences in per worker capital, human capital, and TFP.

**Figure 3: Change in the Gap of per Worker Output and Its Components between the Republic of Korea and the United States, 1960–2010**




Note: The gap is expressed as the log difference in the value of each term between the United States and the Republic of Korea.

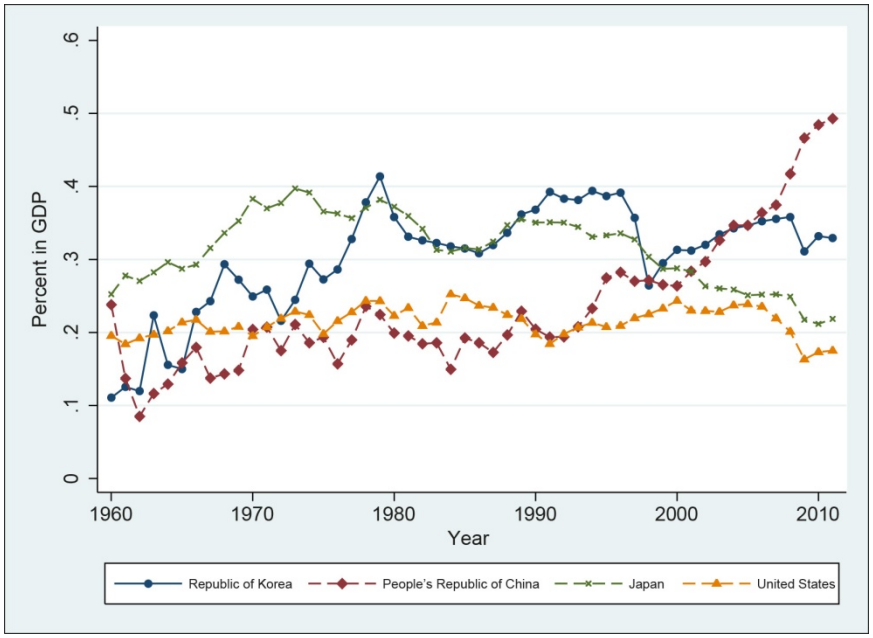
Source: Author's calculations based on equation (4).

The income gap between the Republic of Korea and US continued to decrease over the past half-century. Over time, the gaps in physical capital and human capital per worker also decreased rapidly. By contrast, the productivity gap decreased only until 2000 and then has increased. Currently, the productivity gap is the principal source of the income gap. If the Republic of Korea's productivity level is upgraded from the current 64% to 80% of that of the US, the Republic of Korea's per worker output would jump to 76% of that of the US, with gaps in the relative levels of physical capital and human capital per worker in 2010.

The results of development accounting explain that the Republic of Korea requires productivity improvement to further catch up to the US. During the Republic of Korea's fast catch-up phase of development, factor accumulation played an important role. Consequently, the Republic of Korea now faces a much smaller gap in physical and human capital stock from both its long-run potential and US levels. Thus, according to the prediction of conditional convergence, the Republic of Korea economy will experience slower factor accumulation than it did in previous decades.

In terms of physical capital accumulation, the Republic of Korea has maintained very high investment rates throughout its catch-up process. The real investment–real GDP ratio continued to increase over time, from 10% of GDP in the early 1960s to close to 40% during the 1990s prior to the Asian financial crisis (Figure 4). The ratio dropped significantly during the crisis, recovered gradually to 35%, and then declined again.

**Figure 4: Investment Rates of the People's Republic of China, Japan, Republic of Korea, and United States, 1960–2014**




GDP = gross domestic product.

Source: Feenstra, Inklaar, Timmer (2015).

The low investment rates relative to the pre-crisis level may suggest a permanent negative occurrence.[8] The rate of return of capital declined, as indicated by the Republic of Korea's low real interest rate. The permanent depression of investment would have negative consequences for the Republic of Korea economy's catch-up pace.

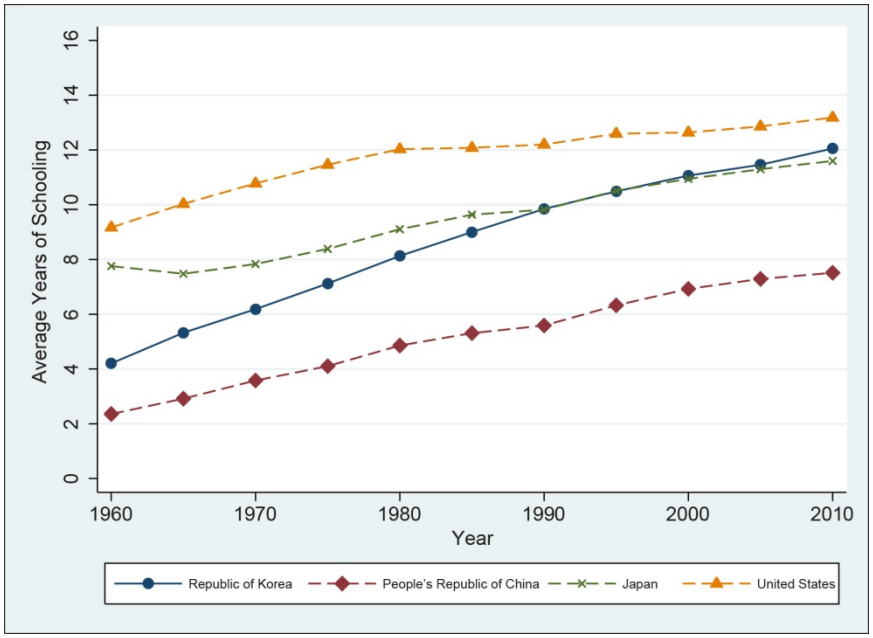
In addition, Figure 4 depicts investment rates for Japan and the PRC. Japan's investment rates increased to 40% in 1973, prior to the oil shock that began in the same year. In recent years, this has slowed to 20%. The PRC's investment rates continued to increase gradually over the 1960s, 1970s, and 1980s, and more rapidly from the early 1990s. The PRC currently invests almost 50% of its GDP, which is disproportionate compared to the historical experiences of Japan and the Republic of Korea.

Concerning the accumulation of human capital, the Republic of Korea's performance has been remarkable. Figure 5 shows that education expanded significantly over the past half-century. The number of average years of schooling increased from only 4.1 years in 1960 to 12.0 years in 2010. As a result, the gap in the average educational attainment between the Republic of Korea and US narrowed substantially. The Republic of Korea's dramatic catch-up reflects the rapid increase in school enrollment

[8] Barro and Lee (2003) suggested that, based on broad international evidence, a financial crisis typically has a persistent adverse effect on investment. In addition, they found that the 1997/98 Asian financial crisis has had a long-term negative impact on investment in the Republic of Korea's economy.

rates for all education levels. Considering that enrollment ratios at secondary and tertiary levels will not increase much beyond current levels—which are among the highest in the world—the speed of the Republic of Korea's human capital accumulation will eventually decelerate.[9]

**Figure 5: Trends of Average Schooling Years of Total Population Aged 15 Years and Over, 1960–2010**




Source: Barro and Lee (2013).

# 3. DETERMINANTS OF ECONOMIC GROWTH AND THE REPUBLIC OF KOREA'S CATCH-UP

## 3.1 Cross-Country Analyses of Economic Growth

This section applies the framework of cross-country analyses of economic growth to investigate the major factors that explain the Republic of Korea's growth and catch-up experience over the past half-century.

The conditional convergence theory implies that each country has its own steady-state levels of per worker output to which it is converging.

The basic framework is expressed as

$$Dy_{it} = \mathrm{f}(y_{it},\ y_i^*) \tag{5}$$

where $Dy_{it}$ is country *i*'s per worker GDP growth rate in period *t*, $y_{it}$ is the country's per worker output, and $y_i^*$ its own long-run (or steady-state) level of *y*. $Dy_{it}$ is inversely related to *y*, indicating conditional convergence of per worker output to its own

[9] The number of average years of schooling does not take into account the differences in the quality of schooling and measurement of skills obtained on the job. Thus, the Republic of Korea could continue to improve the quality of its human resources to catch up to the US. See the discussion of educational quality and adult skills in Barro and Lee (2015).

steady-state level over time. In the cross-country context, countries with higher per worker output would grow slower than those with lower per worker output when controlling for the variables influencing the steady-state level. Consistent with the production function, the dependent variable is expressed as the growth in per worker output rather than per capita output. Note that the per capita output growth rate is calculated by the per worker output growth rate added to the growth rate of the share of the working-age population to the total population.

The long-term level of per worker output depends on various external environmental and policy variables. In the extended neoclassical growth model, the steady-state level of per worker output is determined by investment rate, population growth, and human capital (Mankiw, Romer, Weil 1992). Previous theoretical and empirical studies consider institutions and policy factors as other important determinants of long-run per worker output. These factors include government consumption, institutional quality, macroeconomic stability, trade openness to the world economy, and democracy (Barro and Lee 1994, Barro and Sala-i-Martin 2004).

The empirical framework can be represented by a reduced form, such as[10]

$$Dy_{i,t} = \beta_0 + \beta_1 \log(y_{i,t}) + \beta_2 X_{i,t} + \varepsilon_{i,t,} \quad (6)$$

where *Xi* denotes an array of the variables that influence country *i*'s steady-state level of per worker output.

The regression of equation (6) applies to a panel set of cross-country data for 75 countries over 10 5-year periods from 1960 to 2010: 1960–1965, 1965–1970, 1970–1975, 1975–1980, 1980–1985, 1985–1990, 1990–1995, 1995–2000, 2000–2005, and 2005–2010. The panel is unbalanced, with 713 observations in total. This system of 10 equations is estimated by adopting instrumental variable (IV) estimation techniques to control for the endogeneity of explanatory variables. Instruments are mostly lagged values of the explanatory variables. The estimation results from the IV panel estimation with and without country-fixed effects are presented. The exclusion of country-fixed effects can cause bias of the estimates; however, the fixed-effects technique eliminates information from cross-section variations and could exacerbate measurement errors, especially if the timing of relationships is not known (Barro and Lee 2015).

The representative set of the explanatory variables, $X_i$, includes investment, fertility, and human capital as fundamental growth factors. The stock of human capital is measured by the average years of schooling for the population aged 15–64 years. In addition, the regression includes the reciprocal of life expectancy at birth as a measure of the health of workers in an economy. Five other variables are included to control for institution and policy variables: government consumption, overall maintenance of the rule of law, inflation rate, trade openness, and democracy. A measure for changes in the terms of trade is included as an exogenous factor.[11] In addition, the regressions include period dummies to control for common shocks to per worker GDP growth in all countries.

Summary statistics of the variables for 1965–1970 and 2005–2010 for the Republic of Korea, Japan, PRC, US, and the world are presented in the Appendix.

[10] The specification and data follow those of Barro and Lee (2015), with the updated national accounts data from the Penn World Table 8.1 in Feenstra, Inklaar, and Timmer (2015).

[11] A measure of financial crisis was also considered as an independent variable, but it is statistically insignificant. As discussed in footnote 9, the impact of financial crisis on growth can occur through its adverse effect on investment.

**Table 3: Cross-Country Panel Regressions for per Worker Gross Domestic Product Growth Rate**

| Regression | (1) | (2) |
|---|---|---|
| Log (per worker GDP) | –0.0230*** | –0.0343*** |
| | (0.00236) | (0.00352) |
| Investment/GDP | 0.0364** | 0.0353* |
| | (0.0162) | (0.0208) |
| Log (total fertility rate) | –0.0246*** | –0.0185*** |
| | (0.00445) | (0.00622) |
| Average years of schooling | –0.00352* | –0.00552** |
| | (0.00183) | (0.00243) |
| Average years of schooling squared | 0.000292** | 0.000365** |
| | (0.000122) | (0.000158) |
| 1/Life expectancy | –3.275*** | –2.157** |
| | (0.662) | (0.990) |
| Trade openness | 0.00616** | 0.00702 |
| | (0.00302) | (0.00601) |
| Government consumption/GDP | –0.00954 | –0.00697 |
| | (0.0127) | (0.0153) |
| Rule of law index | 0.0184*** | 0.0115 |
| | (0.00572) | (0.00806) |
| Inflation rate | –0.0163* | –0.0272** |
| | (0.00942) | (0.0132) |
| Democracy index | 0.0402** | 0.0249 |
| | (0.0181) | (0.0224) |
| Democracy index squared | –0.0380** | –0.0200 |
| | (0.0164) | (0.0203) |
| Growth rate of terms of trade | 0.0665** | 0.0588** |
| | (0.0262) | (0.0264) |
| Country fixed effect | no | yes |
| Period dummies | yes | yes |
| No. of economies, observations | 75, 713 | 75. 713 |

GDP = gross domestic product.

Notes:

1. The system has 10 equations, corresponding to 1960–1965, 1965–1970, 1970–1975, 1975–1980, 1980–1985, 1985–1990, 1990–1995, 1995–2000, 2000–2005, and 2005–2010. The sample consists of 75 economies. The system is estimated by adopting instrumental variable (IV) estimation techniques. Instruments are mostly lagged values of the explanatory variables. The dependent variables are the growth rates of per worker GDP.
2. Standard errors are shown in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.
3. The specification and data closely follow those in Barro and Lee (2015), but use the updated national accounts data from the Penn-World Table 8.1 in Feenstra, Inklaar, and Timmer (2015).
4. Per worker GDP levels and growth rates are based on 2005 international prices (adjusted for purchasing power parity).
5. The investment ratio is the ratio of real investment (private plus public) to real GDP.
6. The government consumption measure is the ratio of real government consumption to real GDP, based on the Penn-World Table 8.1. They are averaged over the period.
7. Schooling data are the average years of schooling for the population aged 15–64 years from Barro and Lee (2013).
8. Life expectancy at birth and the fertility rate are from World Bank (2015).
9. The rule of law index, expressed on a 0–1 scale, with 1 being the most favorable, is based on the maintenance of the rule of law index in PRS Group (2015).
10. The inflation rate is the growth rate over each period of a consumer price index.
11. The trade openness variable is the ratio of exports plus imports to GDP.
12. The democracy index, expressed on a 0–1 scale, with 1 being the most favorable, is based on the indicator of political rights compiled by Freedom House (2015).
13. The growth rate of the terms of trade is the change of export prices to import prices over the period.

Column 1 of Table 3 presents the regression results of equation (6) without country-fixed effects. The negative estimate of the coefficient on the first explanatory variable, the log of per worker GDP at the start of each period, reveals a strong conditional convergence effect. The estimated speed of conditional convergence is about 2.3% per year, implying that a country at half of the per worker output level of another country tends to grow by 1.6 percentage points (= 2.3 x ln(2)) faster than the richer country, assuming the same level of long-term per worker output.

The investment rate has a positive and statistically significant effect on growth. The log of the total fertility rate is significantly negative. The estimated coefficient on the reciprocal of life expectancy at birth is negative and highly significant, indicating that better health is associated with higher economic growth.

The regression result shows the nonlinear relationship between human capital stock and growth, as discussed in Barro and Lee (2015). The coefficients on average years of schooling and its square term are negative and positive, respectively, although only the square term is marginally statistically significant. The pattern of the coefficients demonstrates that the growth rate increases with the level of educational attainment only when the society has attained 6.0 average years of schooling. Hence, only countries that have accumulated human capital above a certain threshold are able to experience higher GDP growth induced by an increase in educational attainment for given values of the other explanatory variables.

The regression results show that government policies and institutions play a significant role in determining economic growth. A subjective measure of the extent of maintenance of the rule of law is significantly positive. Increased openness to international trade is a positive determinant for growth, although the estimated coefficient is marginally significant.

The level of democracy has a nonlinear relationship with growth, as found by Barro (1996). The coefficients on the indicator of democracy and its square term are positive and negative, respectively, and both coefficients are jointly statistically significant. The pattern of the coefficients on the indicator of democracy and its square term indicates that the GDP growth rate increases with political freedom at low levels of democracy but decreases with democracy once the society has attained a certain level of political freedom. The threshold level is 0.53. The nonlinear relation suggests that autocracy can have negative effects on growth if a leader uses his or her power to steal the nation's wealth, but more democracy above the threshold level can also retard growth if it promotes income-redistributive policies, rather than pro-growth ones, in systems of majority voting.

Inflation, an indicator of macroeconomic instability, has a negative effect on growth, but the estimated coefficient is not statistically significant. The government consumption–GDP ratio is statistically insignificant. A higher growth rate of the terms of trade (i.e., export prices relative to import prices) has a strong, positive effect on economic growth.

In summary, the regression results in column 1 show that per capita GDP growth has strong relationships with the initial per capita GDP level, investment, fertility, the quality of human resources, rule of law maintenance, trade openness, and democracy.

Column 2 of Table 3 adds country-fixed effects. The results are similar to those of column 1. The estimated coefficient on the log of per worker GDP remains statistically significant. The estimated speed of conditional convergence increases to about 3.4% per year. Since the unobserved country-specific factors that influence the steady-state value of per worker output are likely to have positive relationships with current per worker GDP, the omitted variables tend to bias upward the estimated effect of lagged per worker GDP on growth. Consequently, the inclusion of the country-fixed effects tends to lower the convergence rate below zero.

The results with country-fixed effects show that some economic policy and institutional factors, such as rule of law and trade openness, become statistically insignificant. In contrast, the estimated coefficient on inflation becomes statistically significant.

## 3.2 The Republic of Korea's Economic Growth in Comparative Perspective

The growth regressions imply that the Republic of Korea has grown faster than high-income countries by many factors, including convergence, due to the low level of per worker output relative to its long-term level as well as favorable environmental and policy factors influencing the long-term potential level of per worker output, $y_i^*$, to which the Republic of Korea has been converging.

The Republic of Korea's relatively favorable environment and policy factors have facilitated faster catch-up to the advanced economies than other developing countries with the same level of per worker output over the transition to a higher steady-state level of per worker output. Note that these factors could affect both the rate of factor accumulation and of productivity growth.

The cross-country regression results allow analysis of the growth performance of the Republic of Korea relative to that of the US. The point estimates of the parameters in the regressions of Table 3 are used for simple accounting that breaks down the fitted values of growth rates for each country into the contributions from each explanatory variable. Although the residual errors in individual country growth rates are substantial, it is worthwhile to examine the differences in the explanatory variables that generate the differences in the fitted growth rates. The accounting results can be used to explore the sources of the differences in the fitted growth rates between the Republic of Korea and US.[12]

Table 4 presents the results of the accounting exercise in this study. The basic regression can account for a substantial part of the growth differences between the Republic of Korea and US over time. The predicted growth rates of the Republic of Korea are higher than those of the US over the period. Growth rate differentials are shown by the averages over three subperiods: 1960–1980, 1980–2000, and 2000–2010. The results in panel A of Table 4 are based on the estimates in column (1) of Table 3; the estimated growth rate differentials are 2.0, 2.6, and 3.1 percentage points for each subperiod, while the actual differences are 4.0, 3.9, and 2.9 percentage points. Therefore, the model underestimates the Republic of Korea's relative growth performance in the earlier subperiods.

[12] Using the same technique, De Gregorio and Lee (2004) compared the economic performance of East Asian economies relative to those in Latin America, and showed that the better growth performance of East Asia is largely attributable to "fundamental growth factors," including high savings rates, strong human capital, high trade openness, maintenance of good institutions, and prudent fiscal and monetary management.

**Table 4: Contributions to Growth Differentials between the Republic of Korea and United States, 1960–1980, 1980–2000, and 2000–2010**
(%, annual average)

| | 1960–1980 | 1980–2000 | 2000–2010 | (2000–2010) |
|---|---|---|---|---|
| **Without Country-Fixed Effects (A)** | | | | |
| Difference in | | | | |
| Actual growth | 0.0395 | 0.0387 | 0.0294 | |
| Predicted growth | 0.0195 | 0.0259 | 0.0309 | (100.0%) |
| Initial income | 0.0484 | 0.0294 | 0.0165 | (53.3%) |
| Investment rate | 0.0023 | 0.0046 | 0.0041 | (13.2%) |
| Fertility | –0.0122 | 0.0022 | 0.0132 | (42.8%) |
| Schooling | –0.0070 | –0.0070 | -0.0030 | (–9.6%) |
| Life expectancy | –0.0070 | –0.0028 | 0.0004 | (1.3%) |
| Government consumption | –0.000029 | –0.000023 | –0.000189 | (–0.6%) |
| Rule of law | –0.0092 | –0.0082 | –0.0021 | (–7.0%) |
| Inflation rate | –0.0014 | –0.0003 | –0.0001 | (–0.4%) |
| Democracy | 0.0069 | 0.0062 | 0.0021 | (6.6%) |
| Openness | 0.0010 | 0.0019 | 0.0023 | (7.3%) |
| Terms of trade | 0.000002 | –0.0002 | –0.0022 | (–7.0%) |
| **With Country-Fixed Effects (B)** | | | | |
| Difference in | | | | |
| Actual growth | 0.0395 | 0.0387 | 0.0294 | |
| Predicted growth | 0.0501 | 0.0402 | 0.0356 | (100.0%) |
| Initial income | 0.0721 | 0.0439 | 0.0245 | (68.9%) |
| Investment rate | 0.0023 | 0.0045 | 0.0040 | (11.1%) |
| Fertility | –0.0092 | 0.0017 | 0.0099 | (27.8%) |
| Schooling | –0.0044 | –0.0062 | –0.0029 | (–8.0%) |
| Life expectancy | –0.0046 | –0.0018 | 0.0003 | (0.7%) |
| Government consumption | –0.00002 | –0.00002 | –0.00014 | (–0.4%) |
| Rule of law | –0.0058 | –0.0051 | –0.0013 | (–3.8%) |
| Inflation rate | –0.0024 | –0.0005 | –0.0002 | (–0.6%) |
| Democracy | 0.0016 | 0.0020 | 0.0008 | (2.3%) |
| Openness | 0.0012 | 0.0022 | 0.0026 | (7.3%) |
| Terms of trade | 0.000002 | –0.0002 | –0.0019 | (–5.4%) |

Note: The predicted per capita growth rates in panels A and B are based on the estimation results of columns (1) and (2) in Table 3, respectively.

The cross-country regressions represent the “average” relationships applied to all countries across time. Some individual countries undoubtedly differ in terms of the magnitude of the relationships, and in terms of the list of the most important variables affecting growth. The accounting result indicates that while the basic set of explanatory variables explains most of the differences in growth rates between the Republic of Korea and US, there are other unexplained factors that made the Republic of Korea grow faster than other countries in the sample, in particular, in the 1970s and 1980s.

The accounting exercise in Table 4 breaks down the predicted differences separately into the contributions from the 11 explanatory variables. The result shows that the lower income level of the Republic of Korea compared to that of the US led to higher growth over the whole period because of the convergence effect. However, the magnitude of the convergence effect became smaller over time as the Republic of Korea caught up to the US in per capita income: this effect declined from 4.8 percentage points a year over 1970–1990 to 2.9 percentage points a year in 1980–2000, and then 1.7 percentage points a year in 2000–2010.

While the convergence effect is an important factor explaining the Republic of Korea's growth performance, the rest of the explanatory variables also influenced a significant part of the growth difference. For example, during 2000–2010, the model predicts an average growth rate for the Republic of Korea that is 3.1 percentage points per year higher than that of the US. The convergence effect explains a difference of 1.7 percentage points, while the rest of the factors influencing growth explain the remainder (1.4 percentage points).

The exercise shows that higher investment rates in the Republic of Korea explain about 0.2−0.5 percentage points, and trade openness accounts for about 0.1−0.2 percentage points in growth differentials over the whole period. The gap between the Republic of Korea and US in terms of human resources (i.e., schooling and life expectancy) contributes to lowering the growth of the Republic of Korea relative to that of the US by 1.4 percentage points over 1960–1980. However, as the Republic of Korea experienced improvements in human resources, the human resources variables explain a smaller difference of 0.3 percentage points in 2000–2010.

In addition, the Republic of Korea has improved institutional quality, which has contributed positively to growth. The relatively low level of the rule of law variable accounts for about 0.8−0.9 percentage points of slower growth of the Republic of Korea relative to US over 1960–2000. However, this drops to only 0.2 percentage points in 2000–2010. The Appendix shows the values of the variables in 1965–1970 and 2005–2010 for the Republic of Korea and US. The Republic of Korea has caught up rapidly to the US in human resources, policy, and institutional variables from 1970 to 2010.

The Republic of Korea had higher fertility rates in earlier periods, but now has lower fertility rates than the US. The change in the fertility gap between the Republic of Korea and US is predicted to contribute positively to the higher growth of the Republic of Korea with a net effect of 1.3 percentage points over 2000–2010. Note that the estimated positive effect of fertility is applied to per worker GDP growth rates rather than per capita GDP growth rates. While the decrease in fertility has a positive effect on per worker (or per capita) output growth by lowering population growth and raising the steady-state per worker output, it eventually has a negative effect on per capita output growth when it leads to a decline in the working-age population.

An interesting prediction is that improvement in democracy contributes negatively to the catch-up in recent decades in the Republic of Korea. The Republic of Korea's level of democracy indicator is slightly lower than the critical level of 0.53 in the 1970s and then increases above the critical level in 1989 (0.533). Thereafter, the nonlinear relationship between democracy and growth works unfavorably for the Republic of Korea's catch-up to the US in per capita income.

Panel B of Table 4 presents the predicted growth rates that are based on the estimates in column 2 of Table 3. The estimated growth rate differentials are 5.0, 4.0, and 3.6 percentage points for each subperiod. Therefore, the model overestimates the Republic of Korea's actual growth rate differentials in all subperiods. The effect of

the difference of per worker output levels between the two countries on subsequent growth differentials becomes much larger in panel B than in panel A due to the larger convergence estimate. The predicted effects of the differences in other environment and policy variables—human resources, investment, fertility, rule of law, inflation, democracy, and trade openness—on growth differentials between the Republic of Korea and US are broadly similar to those in panel A.

For the Republic of Korea, the ratio of the working-age population to total population is expected to decline from 73.1% in 2010 to 70.6% in 2020, and further to 62.3% in 2030 (United Nations 2013). The decline in the working-age population ratio has additional negative effects on per capita GDP growth of −0.3% in 2010–2020 and −1.3% in 2020–2030 (Table 5).

**Table 5: Population and Working-Age Population Growth for the People's Republic of China, Japan, Republic of Korea, and United States**
(per year, %)

| Country | Growth | 1960–1970 | 1970–1980 | 1980–1990 | 1990–2000 | 2000–2010 | 2010–2020 | 2020–2030 | 2030–2040 |
|---|---|---|---|---|---|---|---|---|---|
| Republic of Korea | GRp | 2.63 | 1.75 | 1.38 | 0.68 | 0.47 | 0.57 | 0.39 | –0.19 |
| | GRw | 2.12 | 3.07 | 2.47 | 1.00 | 0.66 | 0.22 | –0.87 | –0.95 |
| | GRw–GRp | –0.51 | 1.31 | 1.09 | 0.33 | 0.19 | –0.35 | –1.26 | –0.76 |
| Japan | GRp | 1.03 | 1.11 | 0.53 | 0.28 | 0.07 | –0.12 | –0.41 | –0.51 |
| | GRw | 1.86 | 0.90 | 0.87 | 0.06 | –0.54 | –0.93 | –0.70 | –1.23 |
| | GRw–GRp | 0.82 | –0.21 | 0.34 | –0.22 | –0.6 | –0.81 | –0.29 | –0.72 |
| United States | GRp | 1.27 | 0.93 | 0.97 | 1.09 | 0.94 | 0.73 | 0.64 | 0.49 |
| | GRw | 1.50 | 1.57 | 0.97 | 1.18 | 1.05 | 0.31 | 0.05 | 0.41 |
| | GRw–GRp | 0.24 | 0.64 | –0.01 | 0.09 | 0.11 | –0.43 | –0.59 | –0.09 |
| People's Republic of China | GRp | 2.32 | 1.88 | 1.53 | 1.03 | 0.56 | 0.62 | 0.09 | –0.15 |
| | GRw | 2.14 | 2.54 | 2.56 | 1.34 | 1.45 | –0.07 | –0.31 | –1.06 |
| | GRw–GRp | –0.18 | 0.66 | 1.03 | 0.31 | 0.89 | –0.69 | –0.40 | –0.91 |

GRp = population growth, GRw = working-age population growth.

Source: Author's calculations based on the United Nations (2013).

Overall, the Republic of Korea's historical experience of economic growth and catch-up to the US is largely attributed to the Republic of Korea's favorable growth factors. Relatively low per worker output level, high investment rate, strong human capital, high trade openness, maintenance of good institutions, and low inflation have contributed to strong growth. Since the Republic of Korea's rapidly growing economy has continued to narrow the gap with the US in per capita income and levels of environmental and institutional variables, it has inevitably encountered a slowdown in growth potential.

# 4. SECTOR PRODUCTIVITY AND ECONOMIC GROWTH IN THE REPUBLIC OF KOREA

The Republic of Korea's remarkable economic transformation since the early 1960s has been characterized by fast industrialization and strong economic growth, with the manufacturing sector being a key growth driver. In the early 1960s, the Republic of Korea shifted its economic policy focus from import substitution to export orientation, to support industrialization and economic growth. Export-oriented policies, designed to provide incentives to export firms based on their performance, were effective in pushing the pace of change in comparative advantage. The exposure to

international export markets and performance-based government support stimulated efficiency improvement and faster productivity growth in manufacturing industries, which successfully underwent diversification stages. The numbers of goods produced expanded along with quality upgrades of existing products. Exporters were able to build up their comparative advantage in labor-intensive manufacturing and then to move to more capital- and technology-intensive industries, including electronics, machinery, automobiles, ships, chemicals, and information and communications technology products.

Overall, the Republic of Korea's export-oriented growth strategy has worked in its favor, enabling the country to sustain strong growth and transform into a more technologically advanced economy. However, the strategy has also made the country vulnerable to external shocks. The Republic of Korea economy came to rely increasingly on external demand to drive growth. Exports accounted for about 56% of GDP in 2014 from 15% in 1970 and 34% in 2002. As during the global financial crisis, overreliance on external demand has made the Republic of Korea susceptible to the economic recession in industrial countries as well as drop in global demand.

An imbalance between the Republic of Korea's manufacturing and services sectors is another outcome of its export-promotion strategy that encouraged more investment in manufacturing than in services. Despite the size of the Republic of Korea's services sector, which employs 76% of the country's workers, the sector's contribution to overall economic growth is small, owing to its low productivity. Value added per worker in the services sector remains just 48% of that in the manufacturing sector. Table 6 shows value added per worker for nine sectors, including four services industries for the Republic of Korea, Japan, PRC, and US in 2010.

Within the services sector, the levels of labor productivity across services industries are diverse. In general, labor productivity is relatively high in the transport, storage, and communications industry and the finance, insurance, real estate, and business services industry (Table 6). In contrast, the wholesale and retail trade, hotels, and restaurants industry has shown a lower productivity level relative to the manufacturing sector. It is notable that the finance, real estate, and business services industry had higher labor productivity than the manufacturing sector in Japan, US, and PRC, but had lower productivity in the Republic of Korea in 2010.

The annual labor productivity growth in the services sector was only 1.6%, which is significantly lower than that in the manufacturing sector of 7.7% for 1980–2010 (Table 7) The average annual growth in per worker value added dropped from 2.5% during 1980–1990 to an annual average of 1.2% during 1990–2000 and 1.1% during 2000–2010. The Republic of Korea services industries, including finance, real estate, and business services as well as community and government services, have shown negative or zero growth of per worker value added over all subperiods.

The lower productivity growth of the stagnant services sector relative to the manufacturing sector has been well known since the seminal study of Baumol (1967). Hence, the fact that the Republic of Korea services sector has had relatively lower productivity growth than the country's manufacturing sector is not extraordinary. However, the differentials in labor productivity (i.e., per worker value added) and growth rates in labor productivity between the two sectors have been much larger in the Republic of Korea compared to other industrialized economies.

**Table 6: Ratio of Each Sector's per Worker Value Added to Manufacturing per Worker Value Added in 2010**

| Industry | Republic of Korea | Japan | People's Republic of China | United States |
|---|---|---|---|---|
| Agriculture, hunting, forestry, and fishing | 0.24 | 0.22 | 0.18 | 0.55 |
| Manufacturing | 1.00 | 1.00 | 1.00 | 1.00 |
| Services | 0.48 | 0.94 | 0.64 | 0.64 |
| Wholesale and retail trade, hotels, and restaurants | 0.25 | 0.60 | 0.56 | 0.38 |
| Transport, storage, and communications | 0.61 | 1.00 | 1.06 | 0.83 |
| Finance, real estate, and business services | 0.83 | 1.55 | 1.79 | 1.25 |
| Community and government services | 0.47 | 0.84 | 0.31 | 0.48 |
| Others | 0.74 | 0.95 | 0.83 | 0.82 |
| Mining and quarrying | 1.99 | 1.14 | 1.82 | 2.44 |
| Electricity, gas, and water | 3.64 | 6.41 | 2.70 | 2.90 |
| Construction | 0.59 | 0.72 | 0.50 | 0.48 |
| Aggregate economy | 0.58 | 0.91 | 0.58 | 0.68 |

Notes: Japan uses 2009 values for 2010. For international comparison, the relative level of per worker value added is calculated using nominal value added.

Sources: World KLEMS, http://www.worldklems.net; Asia KLEMS, http://asiaklems.net; and RIETI. China Industrial Productivity (CIP) 3.0 Database. http://www.rieti.go.jp/en/database/CIP2015/index.html.

**Table 7: Growth Rate of per Worker Value Added by Sector**
(%)

| Industry | 1980–1990 | 1990–2000 | 2000–2010 | 1980–2010 |
|---|---|---|---|---|
| **Republic of Korea** | | | | |
| Agriculture, hunting, forestry, and fishing | 7.02 | 5.58 | 4.73 | 5.78 |
| Manufacturing | 7.58 | 9.94 | 5.47 | 7.66 |
| Services | 2.45 | 1.22 | 1.13 | 1.60 |
| Wholesale and retail trade, hotels, and restaurants | 4.90 | 1.34 | 2.56 | 2.94 |
| Transport, storage, and communications | 3.72 | 5.14 | 4.13 | 4.33 |
| Finance, real estate, and business services | –0.55 | –1.05 | –1.37 | –0.99 |
| Community and government services | –0.20 | –0.08 | –1.06 | –0.45 |
| Others | 5.54 | 2.09 | 1.20 | 2.94 |
| Mining and quarrying | 5.12 | 14.84 | –2.07 | 5.96 |
| Electricity, gas, and water | 11.40 | 10.08 | 3.20 | 8.23 |
| Construction | 5.21 | 0.80 | 0.59 | 2.20 |
| Aggregate economy | 5.54 | 4.14 | 2.56 | 4.08 |

*continued on next page*

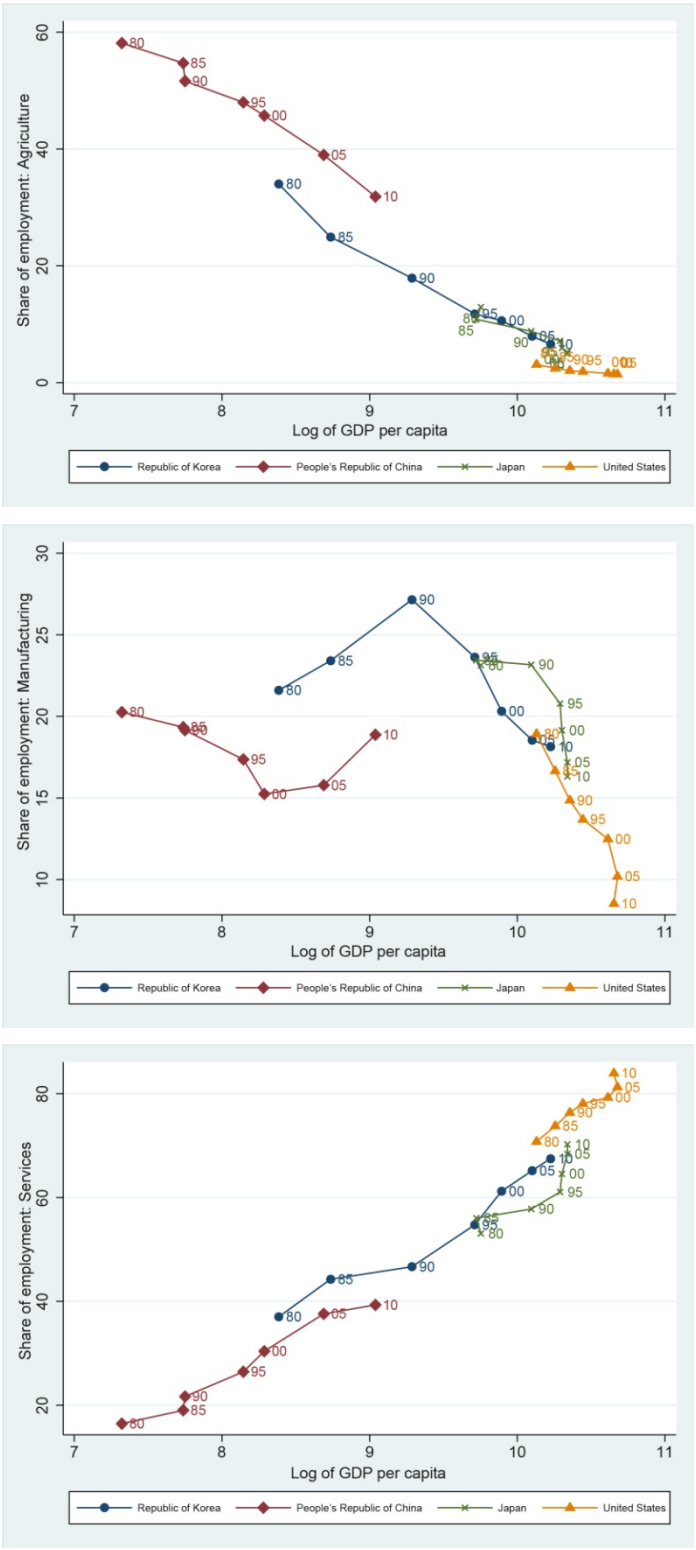
**Table 7** *continued*

| Industry | 1980–1990 | 1990–2000 | 2000–2010 | 1980–2010 |
|---|---|---|---|---|
| **Japan** | | | | |
| Agriculture, hunting, forestry, and fishing | 3.92 | 2.33 | 1.34 | 2.57 |
| Manufacturing | 3.25 | 1.48 | 2.00 | 2.25 |
| Services | 1.39 | 0.45 | 0.26 | 0.71 |
| Wholesale and retail trade, hotels, and restaurants | 2.02 | 1.41 | –0.53 | 1.02 |
| Transport, storage, and communications | 2.43 | 0.96 | 1.93 | 1.77 |
| Finance, real estate, and business services | –0.09 | 0.05 | –0.81 | –0.27 |
| Community and government services | 0.16 | –0.61 | 0.47 | –0.01 |
| Others | 2.91 | –2.30 | 0.66 | 0.42 |
| Mining and quarrying | 1.94 | –0.42 | –1.98 | –0.09 |
| Electricity, gas, and water | 6.16 | 2.69 | 2.39 | 3.79 |
| Construction | 2.53 | –3.41 | 0.37 | –0.19 |
| Aggregate economy | 2.43 | 0.63 | 0.72 | 1.28 |
| **People's Republic of China** | | | | |
| Agriculture, hunting, forestry, and fishing | 2.34 | 2.73 | 4.14 | 3.09 |
| Manufacturing | 10.64 | 19.51 | 14.54 | 15.04 |
| Services | –0.70 | –1.33 | 5.78 | 1.32 |
| Wholesale and retail trade, hotels, and restaurants | –16.02 | –2.76 | 8.64 | –2.95 |
| Transport, storage, and communications | 0.87 | 4.83 | 11.22 | 5.80 |
| Finance, real estate, and business services | 11.02 | 3.41 | –3.00 | 3.56 |
| Community and government services | –2.35 | –8.90 | 2.63 | –2.89 |
| Others | –1.31 | –0.19 | 4.78 | 1.17 |
| Mining and quarrying | –3.65 | 6.39 | 1.43 | 1.56 |
| Electricity, gas, and water | 6.63 | –8.75 | 12.46 | 3.34 |
| Construction | –3.87 | –1.93 | 3.38 | –0.70 |
| Aggregate economy | 4.72 | 7.25 | 9.94 | 7.39 |
| **United States** | | | | |
| Agriculture, hunting, forestry, and fishing | 8.67 | 3.33 | 2.54 | 4.85 |
| Manufacturing | 4.07 | 4.82 | 4.12 | 4.34 |
| Services | 0.34 | 1.16 | 1.32 | 0.94 |
| Wholesale and retail trade, hotels, and restaurants | 3.29 | 3.76 | 1.29 | 2.78 |
| Transport, storage, and communications | 1.40 | 2.09 | 3.59 | 2.36 |
| Finance, real estate, and business services | –1.56 | 0.78 | 2.32 | 0.51 |
| Community and government services | –0.12 | –0.36 | 0.01 | –0.15 |
| Others | 0.24 | –0.73 | –1.25 | –0.58 |
| Mining and quarrying | 6.36 | 1.67 | –3.46 | 1.52 |
| Electricity, gas, and water | –0.26 | 1.26 | 2.08 | 1.03 |
| Construction | –0.55 | –0.45 | –3.03 | –1.34 |
| Aggregate economy | 0.98 | 1.45 | 1.33 | 1.25 |

Notes: Data from the People's Republic of China are from 1981 to 2010, and data from Japan are from 1980 to 2009.

Sources: World KLEMS, http://www.worldklems.net; Asia KLEMS, http://asiaklems.net; and RIETI. China Industrial Productivity (CIP) 3.0 Database. http://www.rieti.go.jp/en/database/CIP2015/index.html.

**Figure 6: Sector Shares of Employment, 1980–2010**
(%)




GDP = gross domestic product.

Sources: Author's calculations based on sector employment data from World KLEMS, http://www.worldklems.net; Asia KLEMS, http://asiaklems.net; and RIETI. China Industrial Productivity (CIP) 3.0 Database. http://www.rieti.go.jp/en/database/CIP2015/index.html. GDP data are from Feenstra, Inklaar, and Timmer (2015).

Figure 6 confirms the stylized pattern of structural change in the literature.[13] An increase in GDP per capita is associated with a decrease in agriculture employment and an increase in employment in the services sector. The manufacturing employment share shows hump-shaped changes. The PRC has been following the stylized pattern, although it had a larger share of employment in the agriculture sector and a smaller share in the manufacturing sector in 2010, compared to the Republic of Korea and Japan in the 1980s.

It is clear that there have been major employment shifts toward the services sector in selected Asian economies over 1980–2010. In the Republic of Korea, the share of employment in the services sector increased dramatically from 37.0% in 1980 to 67.5% over 1980–2010. This share increased in Japan from 53.1% to 70.2% over the same period. In the PRC, the employment share of the services sector increased over the same period from 16.4% to 39.3%.

The low labor productivity of the services sector relative to the manufacturing sector tends to hamper overall productivity growth. Lee and McKibbin (2014) showed a negative relationship between the overall labor productivity growth rate of an economy and the employment share of its services sector.

A key to the Republic of Korea's further growth is to rebalance its economy through diversification of growth sources. A new growth strategy should entail productivity increases in services industries. Structural reforms to stimulate productivity growth in the services sector are essential for sustained long-term growth. One of the effective ways to raise productivity is developing modern services industries, including health care, education, telecommunications, business processing, and legal and financial services (Eichengreen and Gupta 2013). Lowering product regulations and barriers to foreign direct investment would promote more competition and boost new technology innovation. Enhancing services sector productivity is important for the Republic of Korea to obtain a second growth driver that could propel strong, sustainable growth in the future.

# 5. IMPLICATIONS FOR THE PEOPLE'S REPUBLIC OF CHINA'S SUSTAINED GROWTH

As discussed, the Republic of Korea economy, like those of other developing countries, started its conditional convergence and catch-up process with low initial per worker output relative to its own long-run (or steady-state) potential, which provided the opportunity for faster capital accumulation and technology diffusion. Good environmental and policy factors, such as a high investment rate, strong human capital, trade openness, and improved institutions, guided the economy toward a higher level of long-run steady state compared to other economies, enabling the Republic of Korea to realize its strong potential for catching up. For this successful catch-up, the Republic of Korea's manufacturing- and export-oriented growth strategy played a critical role. International trade provided large external markets for Republic of Korea products and facilitated imitation and adoption of advanced technologies. Continuous product diversification and technology upgrading in the manufacturing sector also characterized the Republic of Korea's economic development.

[13] See Chenery (1960); Herrendorf, Rogerson, Valentinyi (2014); and Lee and McKibbin (2014).

The PRC economy has also grown fast over the last 35 years, as it transformed from a controlled socialist economy to a market-oriented economy. During this period, the PRC has shown strong output growth, which averaged more than 9.5% annually, and rapidly narrowed its per capita income gap with the Republic of Korea, Japan, and US. Its unprecedented economic growth since the 1980s reflects a strong convergence effect fueled by economic reform and opening. In addition, abundant human resources, high savings and investment rates, and prudent macroeconomic management have contributed to the strong growth. The PRC's economic power continues to rise, making it the largest economy in the world. Its share of world GDP in PPP terms is projected to reach about 17% in 2015, exceeding that of the US and European Union (IMF 2015). Advancing from upper middle-income to high-income status, the PRC now strives to develop more technologically sophisticated industries.

Although its economy has grown rapidly and its per capita income gap has diminished, the PRC showed increasing average growth rates until recent years. This acceleration of economic growth in the takeoff stage of development also occurred in the Republic of Korea until 1990 and in Japan until 1970 (Figure 2). The PRC caught up fast to the US in terms of per worker output and per capita income. In 1980, the value of per worker output in the PRC remained only 6% that of the US, which rose to 17% in 2010.

Although the PRC has caught up to advanced economies very fast, a significant development gap still exists between the PRC and advanced economies. The PRC's average per capita income level relative to the US in 2010–2014 is lower than the Republic of Korea's level in 1990 and Japan's level in 1970.

Physical capital accumulation has contributed most significantly to the PRC's catch-up process, as it did for the Republic of Korea. The level of physical capital stock per worker in the PRC relative to that of the US increased significantly from 3% in 1970 to 20% in 2010. By contrast, the relative level of productivity increased at a modest rate from 39% to 44% of the US over the same period. Because the current levels of physical capital accumulation, human capital stock, and TFP relative to the US are comparable to the Republic of Korea's levels in the 1970s and 1980s, the PRC must have significant room to catch up to the US in per worker output by increasing factor accumulation and productivity growth. Economic growth can remain strong; however, it will eventually decelerate.

In fact, the PRC economy is currently experiencing a slowdown. The PRC recorded a 6.9% GDP growth rate in 2015, the slowest since 1990, and it is expected to continue slowing. The International Monetary Fund (2016) forecasted a growth rate of 6.3% in 2016 and 6.0% in 2017. The reduced return on investment has lowered physical capital accumulation, as it cannot continue to maintain the unprecedented level of investment ratio over 45%. In addition, labor inputs have dropped due to fertility decline and population aging. With limited institutional and innovative capability, the PRC is struggling to maintain strong technological progress.

For the PRC to continue catching up and to achieve a level of development comparable with that in the Republic of Korea, Japan, or US, a faster growth rate is required in the coming decades, which is why it is important for the PRC to learn from the early development experiences of the Republic of Korea. In particular, the PRC's growth strategy over the next 2 decades should be designed by analyzing the experiences of the Republic of Korea's economy and learning from its successes and failures. Specifically, understanding the role of convergence, technology, institutions, and the manufacturing and services sectors in driving sustained economic growth could help guide PRC economic policies.

Forecasting the PRC's mid- and long-term growth is a debate among scholars and policy makers.[14] The discussion focuses mostly on interpreting the country's growth experience in a global and historical context. For instance, Pritchett and Summers (2014) argued that the PRC's growth could slow to 2%–4% over the next 2 decades, as the PRC will probably succumb to the historically prevalent growth pattern of "regression to the mean." One critical assumption of this view is that the PRC will follow the average pattern of historical experiences across all of the world's economies. On the other hand, Lin (2015) suggested that the PRC has the potential to grow 8% for another 20 years by rapidly narrowing its technology and per capita income gap with those of the US through technological imitation and adaptation through leveraging a "latecomer advantage."

Based on the experience of the Republic of Korea as well as a broad sample of countries over time, a decline of the PRC's growth potential seems inevitable due to the diminishing pace of convergence. If the estimated convergence effect from the cross-country regression prevails, the PRC's per worker GDP growth is expected to decline by 1.6 to 2.4 percentage points when its per worker GDP doubles. The PRC's per worker GDP growth rate was 8.5% over 2000–2010, raising per worker GDP by about 2.26 times over the period. Hence, the convergence effect implies that a smaller per worker GDP gap would lower the per worker GDP growth rate to 5.7%–6.6% in 2010–2020, assuming other environmental and policy variables remain unchanged. Since the working-age population growth rate is estimated to be –0.1% in 2010–2020, the GDP growth rate would also decline to 5.6%–6.5%. The PRC's per capita GDP growth rate would decline further to 5.0%–5.9% by considering its total population growth of 0.6% during 2010–2020.

The PRC's actual per worker GDP growth rate is estimated to be about 7.3% between 2010 and 2015, exceeding the growth estimate. However, the increase in per worker GDP level over the previous 5 years will exert downward pressure on output growth in the coming years. Table 5 shows that the working-age population growth rate will decline from –0.1% in 2010–2020 to –0.3% in 2020–2030. Both the convergence effect and working-age population decline would cause a slowdown of GDP growth in the coming decade. It would be difficult for the PRC to maintain over 6% for GDP growth in the coming decade without significant improvements in institutions and policy factors.

These forecasts are broadly consistent with views that predict a "soft landing" of the PRC economy (e.g., Lee and Hong 2012, World Bank 2013, Cai and Lu 2013, Perkins 2015). Lee and Hong (2012) predicted that the PRC's average potential per worker GDP growth would decline to about 6.1% over 2011–2020 and 5.0% over 2021–2030 under the baseline scenario, which assumes a steady improvement in human capital but no serious policy and institutional reform. This prediction was based on the conditional convergence framework using cross-country growth regression analysis, in which physical capital accumulation, human capital accumulation, and TFP growth are estimated separately and then combined to produce long-run GDP forecasts. In addition, this study showed considerable growth gains of policy reforms in the alternative scenario: when the PRC significantly improves education, research and development stock growth, and maintenance of rule of law, the PRC could achieve average potential per worker GDP growth of about 7.0% over 2011–2020 and 6.2% over 2021–2030.

[14] The discussion in this paragraph is from Lee (2015).

There are significant gaps in human capital and quality of institutions between the PRC and advanced economies (Appendix), indicating that the PRC could stimulate economic growth by more educational investment and institutional reform. The government has been carrying out structural reforms aimed at labor market flexibility and human capital development, privatization of state-owned enterprises, and liberalization of the finance sector. The success of these reforms will improve environmental and policy variables and support productivity growth, thereby offsetting the convergence effect.

In addition, the future of the PRC's growth hinges on policies to promote continuous technological innovation and industrial upgrading, which could contribute to productivity increases in both the manufacturing and services sectors. Increased research and development investment and its more efficient allocation could also stimulate productivity growth.[15] Policies aimed at strengthening the research capacity of domestic firms and protection of intellectual property rights could stimulate innovative activities.

PRC authorities are pushing on with rebalancing from an investment and export-driven economy to a domestic consumption and services-based economy. Effective rebalancing is critical to move the economy to a sustainable growth path, especially under great uncertainties in the global economy. Due to its bigger size, the PRC will have more challenges maintaining its export-led growth than the Republic of Korea. However, premature switching from exports to the domestic sector may hamper overall productivity growth. Reallocating resources from a productive export-oriented industry to a highly unproductive services industry could cause a permanent decline in the economy's productivity (Kim, Lee, McKibbin 2014; Lee 2015).

There are significant gaps in the labor productivity level and growth between the manufacturing and services sectors in the PRC. The average annual growth in per worker value added in the services sector was only 1.3% per year for 1980–2010, which is significantly lower than the manufacturing sector's 15.0%. The annual growth rates in per worker value added increased to 5.8% during 2000–2010 from an annual average of –0.7% during 1981–1990 and –1.3% during 1990–2000. PRC services industries—in particular the wholesale and retail trade, hotels, and restaurants industry and the transport, storage, and communications services industry—showed strong, positive growth of per worker value added in the recent decade. However, the finance, real estate, and business services industry showed negative growth. Sector data are subject to measurement errors because of data constraint at industry level. As discussed by Maddison (2007) and Wu (2014), the official GDP estimates for the "nonmaterial services" are highly likely to be exaggerated.

Hence, the PRC should pursue successful rebalancing along with improved productivity growth. Rebalancing policies alone are unlikely to increase average output growth substantially in the PRC. Enhancing productivity is critical for achieving higher economic growth over the long run (Kim, Lee, McKibbin 2014). The PRC's growth strategy over the next 2 decades still necessitates continuous upgrading in manufacturing and export industries while improving domestic services industries. Improving productivity and achieving more balanced growth will require careful long-term strategies.

[15] According to OECD (2014b), gross domestic expenditure on research and development in 2012 was $257 billion in the PRC. It predicted that the PRC will be the world's top research and development spender by around 2019.

The government has implemented structural change and growth-enhancing polices in gradual and pragmatic ways (Naughton 2007). It has started with rural reform using a dual-track strategy. Markets were first opened in some selected coastal areas and then expanded to other areas. In addition, the government has adopted incremental managerial reform instead of rapid privatization of state-owned enterprises. At a later stage, the government ended its dual-track strategy and adopted more rapid restructuring and downsizing of state-owned enterprises. The economy has made a successful transition from a command economy to a market economy while achieving rapid economic growth. In addition, the PRC has maintained macroeconomic stability as well as political and social stability.

Currently, the PRC faces difficult challenges to continue its reforms. It needs to continue reforms in the factor markets of labor, finance, and land. Furthermore, it must continue to restructure state-owned enterprises and increase domestic competition, especially in the services sector by overcoming pressures from vested interest groups. Yao (2013) asserted that the country's authoritarian government was able to adopt the right growth-enhancing polices at critical points because it was not unduly swayed by any interest group. It is unclear whether the authoritarian regime can continue to maintain its neutrality and perform better than other regimes. Since the economy has become bigger and more unpredictable, government interventions would probably not work as they did before. Furthermore, the rise of the middle class will likely promote political development, particularly democracy, which could lead the population to push for government focus on social welfare policies, which are important but do not necessarily enhance growth.

# 6. CONCLUSION

The recent growth slowdown of the Republic of Korea's economy reflects its diminishing mid- and long-term growth potential due to convergence and structural factors. As argued by the convergence theory, a fast-growing country eventually grows more slowly, encountering difficulties in maintaining the same fast rates of human and physical capital accumulation and technological progress.

The Republic of Korea's recent growth slowdown is also attributable to its unbalanced economic structure. Export-oriented policies have caused the Republic of Korea to depend overly on manufacturing exports for growth. Increased imbalance between the manufacturing and services sectors hampers the productivity growth of the overall economy. Due to its low productivity growth, the contribution of the services sector to overall economic growth is small, despite its increasing size. Moreover, owing to overdependence on external demand, the Republic of Korea's economy has become prone to risk from global economic cycles, as demonstrated by its experience during the recent global financial crisis. External demand may not assure the Republic of Korea of a continued market for its exports in the post-crisis global environment, in which the recovery of advanced economies remains sluggish and the PRC economy—the Republic of Korea's largest trading partner—begins to slow rapidly. The Republic of Korea needs structural reforms and productivity growth, particularly in its services sector, for more balanced and sustained growth.

Like the Republic of Korea, the PRC's economic slowdown is an inevitable trend, partly an outcome of its earlier success. The PRC has narrowed its income gap continuously from its long-run potential over time; according to the prediction of conditional convergence, economies with higher initial income can expect slower growth. The PRC's average potential GDP growth will decline to 5%–6% over the coming decade, unless it significantly improves institutions and policy factors. The slowdown could be accelerated if policy makers make major mistakes in handling domestic weaknesses and political transformation.

The data indicate that the Republic of Korea and PRC have had more favorable conditions for rapid growth than other developing countries by maintaining strong investment, high trade openness, and macroeconomic stability, and by improving the quality of human resources and institutions continuously. The future of economic growth in the Republic of Korea and PRC hinges critically on reforms and policies that could contribute to increasing productivity, at least partially offsetting the growth deceleration due to convergence in the coming decades.

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# APPENDIX

**Table A: Summary of Key Variables for the World, People's Republic of China, Japan, Republic of Korea, and United States, 1965–1970 and 2005–2010**

| | Republic of Korea | Japan | People's Republic of China | United States | World |
|---|---|---|---|---|---|
| **1965–1970** | | | | | |
| Per worker GDP growth | 0.072 | 0.090 | 0.015 | 0.018 | 0.032 |
| Per worker GDP in 1965 | 2,354 | 10,626 | 1,721 | 30,046 | 8,977 |
| Investment/GDP | 0.237 | 0.317 | 0.153 | 0.208 | 0.191 |
| Fertility rate in 1965 | 5.157 | 2.139 | 5.872 | 2.913 | 5.173 |
| Schooling in 1965 | 5.676 | 7.796 | 3.400 | 10.416 | 4.108 |
| Life expectancy in 1965 | 56.82 | 70.20 | 51.29 | 70.22 | 58.17 |
| Trade openness | 0.165 | 0.186 | 0.018 | 0.096 | 0.363 |
| Government consumption | 0.147 | 0.162 | 0.164 | 0.143 | 0.166 |
| Rule of law index | 0.500 | 1.000 | 0.500 | 1.000 | 0.576 |
| Inflation | 0.117 | 0.053 | 0.040 | 0.042 | 0.062 |
| Democracy index | 0.474 | 0.951 | 0.117 | 0.946 | 0.643 |
| Terms of trade | 0.002 | –0.001 | 0.002 | 0.001 | 0.002 |
| **2005–2010** | | | | | |
| Per worker GDP growth | 0.029 | 0.010 | 0.095 | –0.002 | 0.019 |
| Per worker GDP in 2005 | 34,012 | 46,378 | 8,059 | 64,366 | 23,361 |
| Investment/GDP | 0.345 | 0.244 | 0.394 | 0.212 | 0.227 |
| Fertility rate in 2005 | 1.076 | 1.260 | 1.668 | 2.054 | 2.771 |
| Schooling in 2005 | 12.272 | 12.124 | 8.020 | 13.011 | 8.531 |
| Life expectancy in 2005 | 78.43 | 81.93 | 72.17 | 77.34 | 70.45 |
| Trade openness | 0.722 | 0.374 | 0.312 | 0.283 | 0.662 |
| Government consumption | 0.128 | 0.171 | 0.217 | 0.113 | 0.174 |
| Rule of law index | 0.833 | 0.833 | 0.750 | 0.833 | 0.642 |
| Inflation | 0.030 | –0.001 | 0.029 | 0.022 | 0.051 |
| Democracy index | 1.000 | 1.000 | 0.000 | 1.000 | 0.738 |
| Terms of trade | –0.032 | –0.009 | –0.001 | 0.001 | 0.006 |

GDP = gross domestic product.

Notes: For the world, the figures are unweighted averages of the sample of the 75 economies that are used in the regressions in Table 3. See the notes to Table 3.